REMARKS

Claims 1 to 4 and 17 to 49 are pending in this application after this amendment.

Claims 5 to 16 have been cancelled because they differed from claim 1 only in the language of the preamble and were therefore of the same scope as claim 1.

Amendments to the Specification

The Specification has been amended for clarity and to correct some minor grammatical and typographical errors. The Applicant submits that these amendments introduce no new matter into the Specification.

The amendments to the claims correct some minor errors. The amendments to claims 1 and 21 are submitted to clarify these claims.

Claim Rejections Under 35 U.S.C. §102

The Examiner has rejected claim 1 under 35 U.S.C. §102(b) as being anticipated by Welch et al. The Applicant submits that claim 1 is not anticipated by Welch et al.

Welch et al, as understood, discloses an optical cross-connect switch in which light from incoming optical fibers is expanded and collimated to a width of approximately 200 μm (see col. 4, ln. 5-7). The collimated beam of light is coupled to a column of angled grating switches (17). By definition, a collimated beam of light is not focussed. It is clear that Welch et al. do not teach focusing a selected input light beam on a first switching element and then focusing the selected input light beam on a second switching element as claimed in claims 1, 5, 9 and 13. Therefore, the Applicant submits that claims 1, 5, 9 and 13 are not anticipated by Welch et al.

Claim Rejections Under 35 U.S.C. §103

The Examiner has expressed the view that claims 2, 4, 17 19, 21 and 23 are unpatentable because they cover obvious combinations of features disclosed in Welch et al., which is described above, and Iida et al.

Iida et al., as understood, disclose a spectrophotometer which incorporates a zoom lens (40). The zoom lens remains focussed on the surface of a sample being studied. The zoom of the lens can adjusted t view a larger or smaller portion of the sample.

The Examiner suggests that it would have been obvious to modify Welch et al. to "have the focusing comprise of varying the focal length of an adaptive optical element". The Examiner indicates that the motivation for doing so would be to "increase the efficiency of the device since varying the focal length would enable focusing without having to physically move the selected reflective switching element or the focusing lens to vary the focal length". The Applicant submits that there is no need in the Welch et al. device for an adaptive optical element because, as noted above lens assemblies (21) expand and collimate light from optical fibers (13). The light is not focussed onto angled grating switches (17). In the Welch et al device there is no need to "match the focal length corresponding to a selected reflective switching element" as suggested. Indeed, it is believed that the angled grating switches (17) disclosed by Welch would not function correctly if the incident light were focused onto the angled grating switches (17).

In light of the foregoing, the applicant submits that claims 2, 4, 17 19, 21 and 23 patentably distinguish the combination of Welch et al. and Iida et al.

The Examiner has rejected claims 3, 18 and 22 as being directed to obvious combinations of the features of Welch et al., Iida et al., and Nishikawa et al. These claims recite that the adaptive optical element comprises a variable mirror device.

While variable mirror devices are known, the applicant submits that they are not known in the context of claims 3, 18 and 22. All of these claims depend from one of the claims discussed above. As discussed above, these claims are submitted to not be obvious in light of Welch et al. and Iida et al. Further, Nishikawa et al. fails to remedy the above-noted deficiencies of Welch et al. and Iida et al. Therefore, the Applicant submits that claims 3, 18 and 22 patentably distinguish the combination of Welch et al., Iida et al., and Nishikawa et al.

The Examiner has rejected claims 20 and 24 as being directed to obvious combinations of the features of Welch et al., Iida et al., and Silver. These claims recite that the adaptive optical element comprises a variable micro-machined membrane lens.

While variable micro-machined membrane lenses are known, the applicant submits that they are not known in the context of claims 20 and 24. These claims both depend from one of the claims discussed above. As discussed above, these claims are submitted to not be obvious in light of Welch et al. and Iida et al. Further, Silver fails to remedy the above-noted deficiencies of Welch et al. and Iida et al. Therefore, the Applicant submits that claims 20 and 24 patentably distinguish the combination of Welch et al., Iida et al., and Silver.

New claims 25 to 49 are submitted to be fully supported by the Specification of this application and to distinguish the prior art of record.

The Applicant respectfully requests reconsideration of this application in light of the foregoing amendments and comments. The applicant submits that this application is now in condition for allowance.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification

Amend the first paragraph on page 2 to read as follows:

The field of communications has benefited enormously from the introduction of optical communications technology. Fundamentally, this technology exploits the inherent bandwidth potential of the light itself as a carrier. As this technology matures, the need for the direct optical processing of [the] signals is becoming greater. Much of the communications infrastructure in operation in the field relies on optical signals being converted back to electrical form for [much of the] certain processing and management functions. Direct optical processing has the benefit of avoiding the need for such conversion [equipment] with its associated costs, losses and amplification requirements.

Amend the last paragraph on page 2 to read as follows:

A variety of specific [individual device] structures for optical crossbar switches have been proposed [and fabricated to address this application]. While many of these rely on non-linear optic materials to obtain switching actions, a very popular way to achieve this end at the time of this application for letters patent is by means of micro-electromechanical structures. These are usually micro-mirror devices that tilt, flex, or flip upon application of an appropriate control voltage.

Amend the third paragraph on page 3 to read as follows:

At the device level, this creates a [requirement] desire for the reflective elements to have the highest possible natural resonant frequency. While materials choice for the reflective element can help to make this frequency as high as possible,

the very size of the mirror structure is a core issue. The reflective element needs to be as small as possible.

Amend the fourth paragraph on page 3 to read as follows:

This requirement presents a problem in that the small apertures involved in the cores of the optical fibers carrying [the] light [signal] signals lead to considerable beam divergence, which is typically addressed via micro-lenses to collimate the emerging beam. However, this collimation is also inherently limited by the aforementioned aperture dimensions with the result that it is very difficult to maintain very narrow beam widths across the lateral extent of a multi-channel crossbar switch. The mirrors therefore have to be larger than the beam width in order to reflect most of the incident beam. This requirement for larger mirrors is contrary to the need for high speed switching.

Delete the first two paragraphs on page 4.

[It is an objection of the present invention to provide a method by which the light beams in an optical cross-connect or crossbar switch may be manipulated is such a way as to provide the maximum reflected optical signal whilst still providing the smallest possible mirror dimensions and highest associated switching speed.

It is a further objective of the present invention to make possible the fabrication of crossbar-switches with larger numbers of channels.]

Amend the first paragraph on page 6 to read as follows:

[In this application for letters patent,] In the illustrated embodiment, the micro-machined mirrors are flipped into and out of reflecting positions. It will be clear to those skilled in the art that there is a variety of mechanisms by

which these mirrors might be moved to serve the same function[.], including various forms of rotation and translation. Flipping them up or down has been selected for the preferred embodiment of the present invention because this method is both simple and proven. Optical cross-connects (or crossbar switches) using micromachined mirrors are well-known in the art and need not be detailed here any further. They are commercially available from companies such as Lucent Technologies of Murray Hill, New Jersey.

<u>In the Claims</u>

1. (Once Amended) A method for [increasing the number of channels in] <u>operating</u> an optical crossbar switch [with] <u>having</u> a plurality of selectable reflective optical switching elements, said method comprising<u>:</u>
   [a.] focusing a selected input light beam on a first selected reflective optical switching element [and] <u>, the first selected reflective optical element directing the selected input light beam to a first output;</u>
   [b.] selecting a second reflective optical switching element<u> ; and,</u>
   [c.] focusing [a] said selected input light beam on said second selected reflective optical switching element<u>, the second selected reflective optical element directing the selected input light beam to a second output</u>.

2. (Once Amended) A method as in claim 1, wherein said focusing comprises varying [the]<u> a </u> focal length of an adaptive optical element.

20. (Once Amended) A method as in any one of [claim] <u>claims</u> 4 [, claim 8, claim 12 or claim] <u>and</u> 19 wherein said variable lens [is] <u>comprises</u> a variable micro-machined membrane lens.

21. (Once Amended) An optical crossbar switch for switching input light beams, the switch comprising :

[a.] at least one adaptive optical element [with variable] having a focal length variable over a range, the adaptive optical element located in a path of a selected input light beam; and,

[b.] a plurality of selectable reflective optical elements, said selectable reflective optical elements [alternately] alternatively selectable and interposable in the path of [a] the selected input light beam to direct the selected input light beam to a corresponding one of a plurality of outputs; [and] wherein more than one of said selectable reflective optical elements [being] are located within the range over which said adaptive optical element is capable of focusing said selected input light beam.

24. (Once Amended) An optical crossbar switch as in claim 23 wherein said variable lens [is] comprises a variable micro-machined membrane lens.